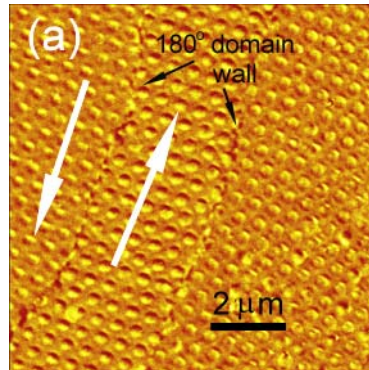
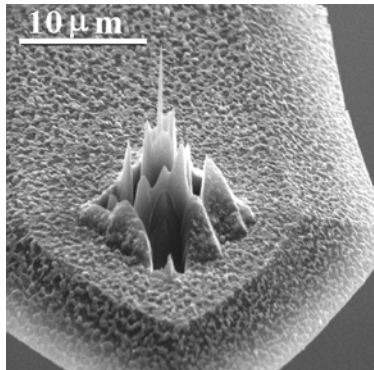
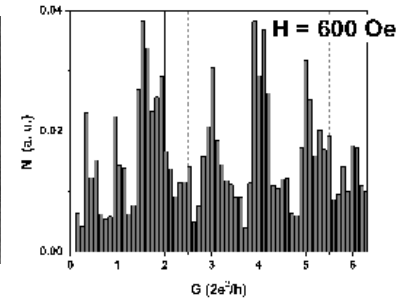
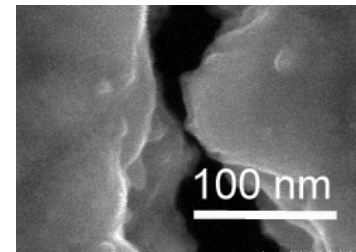
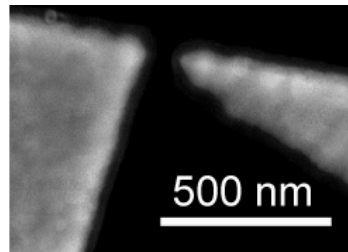


Fabrication of Nanometer-Size Materials using Focused Ion Beam Milling

S. H. Liou, B. Doudin, University of Nebraska, DMR-0116780

Recent Activities

A focused ion beam (FIB) milled magnetic force microscopy (MFM) tip with a magnetic particle at the end of the tip. (The left of bottom Fig.) MFM image of Co-C film prepared by laser interference lithography. The reversed contrast of the dots shows the existence of 180° domain walls (as indicated by the black arrows). Nanodots form “macro”-domains (as indicated by white arrows) in the demagnetized state.



FIB milling is used for opening a gap between two Au electrodes on a SiO_2/Si substrate. Sub-100 nm separation, with 10 nm resolution, is an ideal versatile method for shaping the initial substrate, over which plating of a magnetic film (Ni film in the middle of above Fig.) will be performed under in-situ monitoring of the electrical resistance between the two electrodes. The right Fig. is the histogram of 20 samples. Quantum conductance, related to electrical contacts made of a few atoms, is observed at integers multiples of $2e^2/h$. Odd multiples of e^2/h reveal the absence of spin degeneracy for magnetic materials.

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Education, Outreach and Mentoring

Undergraduates, graduate students and post docs use the focused ion beam (FIB) milling station and the scanning probe microscope (SPM) to fabricate and characterize many different samples in the course of their research. Top right figure is graduate student Lu Yuan milling a resistance bridge from a single crystal of CrO_2 . [Bottom left figure is graduate students Lan Gao and LeighAnn Nicholl characterizing the domain structure of nanometer-size magnetic arrays using magnetic force microscopy.]



Each year, many undergraduates get hands-on experience doing research through the Undergrad Creative Activities and Research Experiences (UCARE) program at the University of Nebraska Lincoln. We also assist in the Saturday Science program. This program helps 5th graders get excited about physics. In the future, we expect more research participants from the Materials Research Science and Engineering Center program, recently funded by NSF.